# Temperature and Microstructural Influences on Luminescent Thin Films

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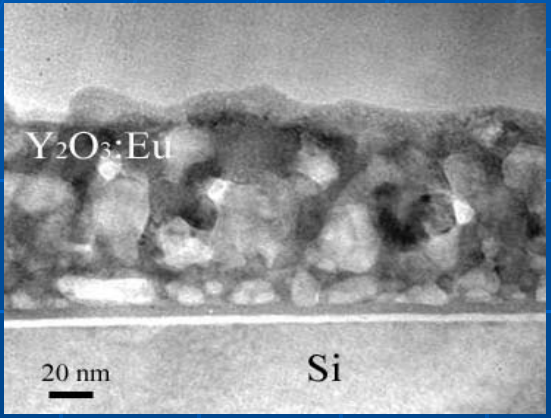
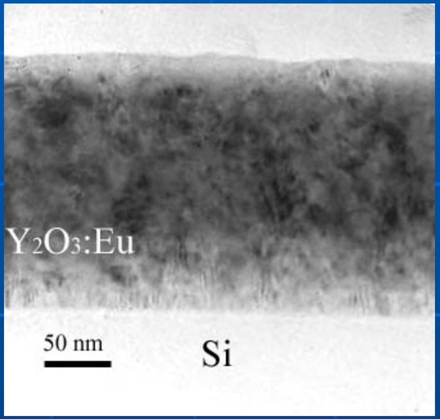


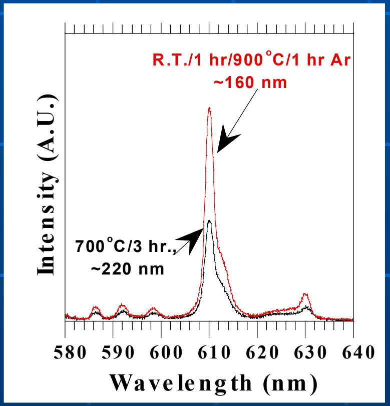

$Y_2O_3$:Eu, deposited room temperature/ 3 hr., annealed 900°C/1 hr. in Ar



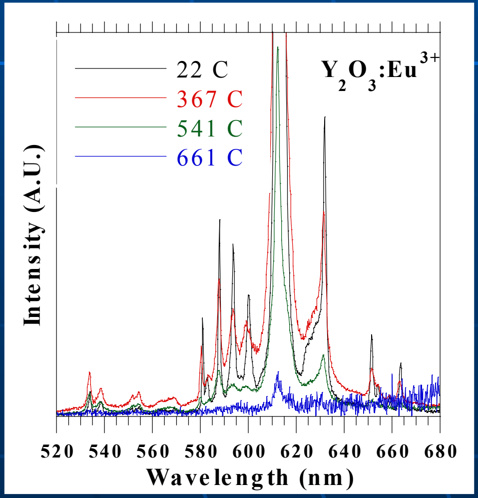

$Y_2O_3$:Eu Deposited 700°C/3 hr. No post annealing

Microstructural differences in thin-films influence the luminescent properties of $(Y_{1-x}Eu_x)_2O_3$

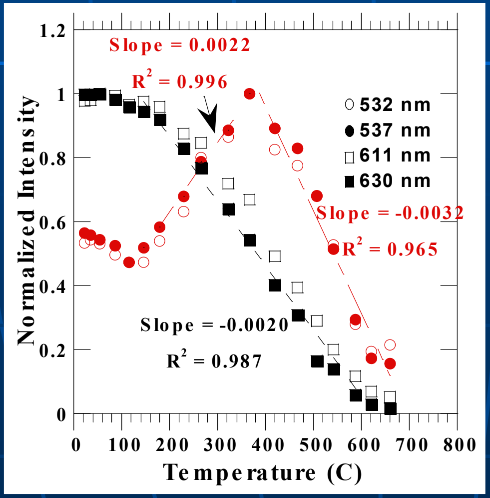
*Defects, such as grain boundaries, crystallite size and phase, affect luminescent intensity and spectral properties*




Luminescent emission intensity affected by microstructure




Temperature influence on luminescent emission of $Y_2O_3$:Eu




Normalized intensity for $^5D_0$ and $^5D_1$ to $^7F_J$ transitions as a function of temperature

Luminescent thin-films can be used as temperature sensors

*The spectral characteristics change as a function of temperature – an accurate and remote sensing method.*

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The TEM micrographs show films produced using rf sputtering.  Amorphous films result from room temperature depositions. After annealing the films at 900°C for 1 hr. in argon, large crystallites are formed and a highly luminescent film is produced.  If deposition is carried out at elevated temperature (700°C), the microstructure of the films exhibit nanocrystalline columnar growth and have reduced luminescent intensity [see top graph]. As the micrographs show, the annealed film has 50 nm size crystallites, while the films grown at 700°C have crystallites < 30 nm.  For small crystallites, the luminescent intensity is reduced due to more activators (Eu) interacting with the grain boundaries, producing phonons instead of the photons.

The lower left figure shows how the spectral properties of $(Y_{1-x}Eu_x)_2O_3$, which is characterized by its intense line emission at 611 nm, change as a function of temperature.  As the temperature of the films rises, the intensity of the emission lines decrease until the emission is finally quenched at around 700°C.  The lower right figure shows how the intensity of some of the emission lines are influenced by temperature.  When a temperature of 150°C is reached, the intensity of the 611 nm and 630 nm lines start to decrease linearly with temperature.  By modeling this behavior, this thin luminescent film can be used a remote temperature sensor.